

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Turlock Irrigation District)	
)	
and)	Project No. 2299
)	
Modesto Irrigation District)	

2005 LOWER TUOLUMNE RIVER ANNUAL REPORT

Report 2005-4

2005 Grayson Screw Trap Report

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Outmigrant Trapping of Juvenile Salmonids in the Lower Tuolumne River at Grayson 2005

FINAL REPORT

March 2006



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Submitted to
Turlock and Modesto Irrigation Districts



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INTRODUCTION

Study Area Description

The Tuolumne River is the largest of the three major tributaries (Tuolumne, Merced, and Stanislaus Rivers) to the San Joaquin River, originating in the central Sierra Nevada and flowing west between the Merced River to the south and the Stanislaus River to the north (Figure 1). The San Joaquin River itself flows north and joins the Sacramento River in the Sacramento-San Joaquin Delta. The Tuolumne River is dammed at several locations for generation of power, water supply, and flood control – the largest impoundment is Don Pedro Reservoir. The lower Tuolumne River corridor extends from its confluence with the San Joaquin River to La Grange Dam at river mile (RM) 52.2. The La Grange Dam site has been the upstream limit for anadromous migration since 1871.

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Figure 1. Location map of study area on the Tuolumne River.

Purpose and History of Study

Rotary screw trap monitoring has been conducted annually near the mouth of the Tuolumne River since 1995 for the purpose of monitoring the abundance and migration characteristics of juvenile salmonids and other fishes. Trapping was conducted at the Shiloh Bridge (RM 3.4) from 1995 through 1998 by Turlock and Modesto Irrigation Districts (Districts) and California Department of Fish and Game (CDFG), at Grayson (RM 5.2) from 1999 through 2003 by CDFG, and from 2004 through 2005 by S.P. Cramer & Associates (SPC). The sampling periods have varied greatly between years with monitoring starting anywhere between January 3 and April 18, and ending anywhere between May 24 and July 1 (Table 1). Shorter sampling seasons from 1995 through 1998 were mainly associated with smolt survival studies using coded wire tagged (CWT) Merced River Hatchery salmon under the Don Pedro Project fish study program. With funding provided by the CVPIA sampling periods were longer from 1999 through 2002. The Don Pedro Project fish study program ended smolt survival studies in 2002. An initial summary of sampling conducted from 1995 through 2004 can be found in the Summary Report for the Lower Tuolumne River (TID/MID 2005).

Table 1. Lower Tuolumne River outmigrant trapping history.

<u><i>Year</i></u>	<u><i>Location</i></u>	<u><i>Start Date</i></u>	<u><i>End Date</i></u>	<u><i>Results Reported In</i></u>
1995	Shiloh (RM 3.4)	April 25	June 1	Heyne and Loudermilk 1997
1996	Shiloh (RM 3.4)	April 18	May 29	Heyne and Loudermilk 1997
1997	Shiloh (RM 3.4)	April 18	May 24	Heyne and Loudermilk 1998
1998	Shiloh (RM 3.4)	February 15	July 1	Blakeman 2004
1999	Grayson (RM 5.2)	January 12	June 6	Vasques and Kundargi 2001
2000	Grayson (RM 5.2)	January 9	June 12	Vasques and Kundargi 2001
2001	Grayson (RM 5.2)	January 3	May 29	Vasques and Kundargi 2002
2002	Grayson (RM 5.2)	January 15	June 6	Blakeman 2004
2003	Grayson (RM 5.2)	April 1	June 6	Blakeman 2004
2004	Grayson (RM 5.2)	April 2	June 8	Fuller 2004

METHODS

Juvenile Outmigrant Monitoring

Trapping Site and Sampling Gear

In 2005, two rotary screw traps were fished side-by-side in the mainstem of the lower Tuolumne River near Grayson (RM 5.2) to sample juvenile salmonids and other fishes as they migrated downstream. The screw traps, manufactured by E.G. Solutions, consisted of a funnel shaped cone suspended between two pontoons. Each trap was positioned in the current so that water entered the eight-foot wide funnel mouth and struck the internal screw core, causing the funnel to rotate. As the funnel rotated, fish were trapped in pockets of water and forced rearward into a livebox, where they could not escape.

The traps were initially held in place by an overhead cable strung between an anchor in the north bank levee and a tree on the south bank. However, the anchor points began to fail on the first night that the traps were fished. Sampling was temporarily suspended until the overhead cable was re-strung between two large trees located on opposing banks and approximately 75 yards downstream from the original trapping site. At both locations, leader cables descended from the overhead cable and were attached to the front of each of four trap pontoons. The downstream force of the water on the traps kept the leader cables taut (see cover photo).

Trap Monitoring

The traps were initially installed between March 29 and April 1, 2005, and sampling began on April 1. The traps sampled for only one night before the anchoring points on both the north and south banks began to fail due to a combination of saturated soil and the force caused by high flows ($>7,000$ cfs). The traps were temporarily raised until an alternative anchoring system was implemented on April 5, and sampling began immediately thereafter. From April 5 until sampling was terminated on June 17, the traps were operated continuously (24 hours per day, 7 days per week), with the exception of the traps being raised from June 11-13.

The traps were checked twice daily throughout the sampling period, once in the morning and once in the evening. During each trap check, we removed the contents of the liveboxes, identified and counted all fish captured, and noted if any fish were marked. In addition, random samples of up to 50 Chinook and 20 of each non-Chinook species during each morning check and up to 20 Chinook and 10 of each non-Chinook species during each evening check were anesthetized, measured (forklengths in millimeters), and recorded. In addition, Chinook smolting appearance was rated on a scale of 1 to 3, with 1 indicating an obvious parr (highly visible parr marks) and 3 an obvious smolt (silvery appearance, easily shed scales, blackened fin tips).

Chinook daily catch was equivalent to the sum of Chinook captured during a morning check plus the number of Chinook captured during the preceding evening check. For example, the daily Chinook catch for April 10 is the sum of Chinook from the morning trap check on April 10 and the evening trap check conducted on April 9. Separate daily catch data was maintained for marked and unmarked Chinook salmon.

After all fish were measured and recorded, we cleaned the traps to prevent accumulation of debris that might impair trap rotation or cause fish mortality within the liveboxes. Trap cleaning included removal of debris from all trap surfaces and from within the liveboxes. The amount of debris load in the liveboxes was estimated and recorded whenever the traps were checked.

Experimental Releases

Smolt Survival Releases Conducted by CDFG

Although the Don Pedro Project fish study program ended smolt survival studies in 2002, CDFG independently conducted a study during 2005. A total of 78,854 CWT hatchery salmon (tag code 05-51-36) were released at La Grange on April 18. Tagged fish were recovered at Grayson and daily passage of CWT hatchery salmon was estimated (see “Estimating Trap Efficiency and Juvenile Abundance”).

Trap Efficiency Releases

Experimental releases were not conducted during 2005 to evaluate trap efficiency.

Estimating Trap Efficiency and Juvenile Abundance

In previous years, trap efficiency estimates were developed by regressing trap efficiency test results against river flow at Modesto (Fuller 2004; Vasques and Kundargi 2001). Annual regression equations were then used to predict trap efficiency for a given day based on the daily average river flow at Modesto. However, no trap efficiency tests were conducted during 2005 so a regression equation for estimating daily trap efficiency was derived from observations made in past years when flow conditions were similar to 2005.

Secondarily, the proportion of flow sampled by the traps was also used as surrogate for trap efficiency. Specifically, the proportion of flow sampled was estimated by the following equation:

$$P = \frac{V_n \left(3.14 * \frac{r^2}{2} \right) + V_s \left(3.14 * \frac{r^2}{2} \right)}{F}$$

where, P is the estimated proportion of flow sampled, V_n and V_s are the daily measured velocities at the mouth of the north and south traps, r is the radius of each trap, and F is the daily flow measured at Modesto. If velocity data were not available for one or both of the traps on a given day, the average of all velocity measurements taken during the season was substituted.

Daily fish passage for unmarked and CWT salmon was estimated by dividing daily catch by the daily trap efficiency estimate and then summed to obtain total estimated outmigrant passage for the entire sampling period. Estimates were calculated separately for unmarked and CWT salmon, and using each of the two methods described for estimated trap efficiency. Data used for passage calculations are provided in Appendix A.

Monitoring Environmental Factors

Flow Measurements and Trap Speed

Provisional daily average flow for the Tuolumne River at Modesto was obtained from the USGS at http://waterdata.usgs.gov/ca/nwis/dv/?site_no=11290000&agency_cd=USGS. Velocity of water entering the traps was measured using two methods. First, we measured the water velocity entering the traps each day with a Global Flow Probe, manufactured by Global Water (Fair Oaks, CA). Second, each morning we calculated an average daily trap rotation speed for each trap by measuring the time, in seconds, for three contiguous revolutions. Separate measurements were taken each morning before and after the traps were cleaned. The average time per revolution before and after cleaning was then calculated for each trap.

River Temperature and Relative Turbidity

Instantaneous water temperature was measured daily with a mercury thermometer or YSI meter (model 550A) at the trap site. An hourly recording thermograph was also

maintained by the Districts near the Grayson trapping site at Shiloh Road (RM 3.4). Instantaneous turbidity was measured daily with a LaMotte turbidity meter, model 2020. A water sample was collected each morning and later tested at the field station. Turbidity was recorded in nephelometric turbidity units (NTU).

RESULTS AND DISCUSSION

Chinook Salmon

Number of Unmarked Chinook Captured

Juvenile Chinook salmon outmigration in the San Joaquin Basin may extend from January through May (Vasques and Kundargi 2001; SRFG 2004). Since no sampling occurred at Grayson from January through March, the 2005 outmigration data is incomplete and underestimates the juvenile Chinook population.

Daily catches of juvenile Chinook at Grayson between April 5 and June 17, 2005, ranged from 0 to 57 fish and totaled 1,317 fish (Figure 2). Chinook salmon were captured every day the traps sampled between April 10 and June 17, and daily catches were highest from late-April through late-May. There was no clear relationship observed between Chinook catch and river flow during 2005 (Figure 2).

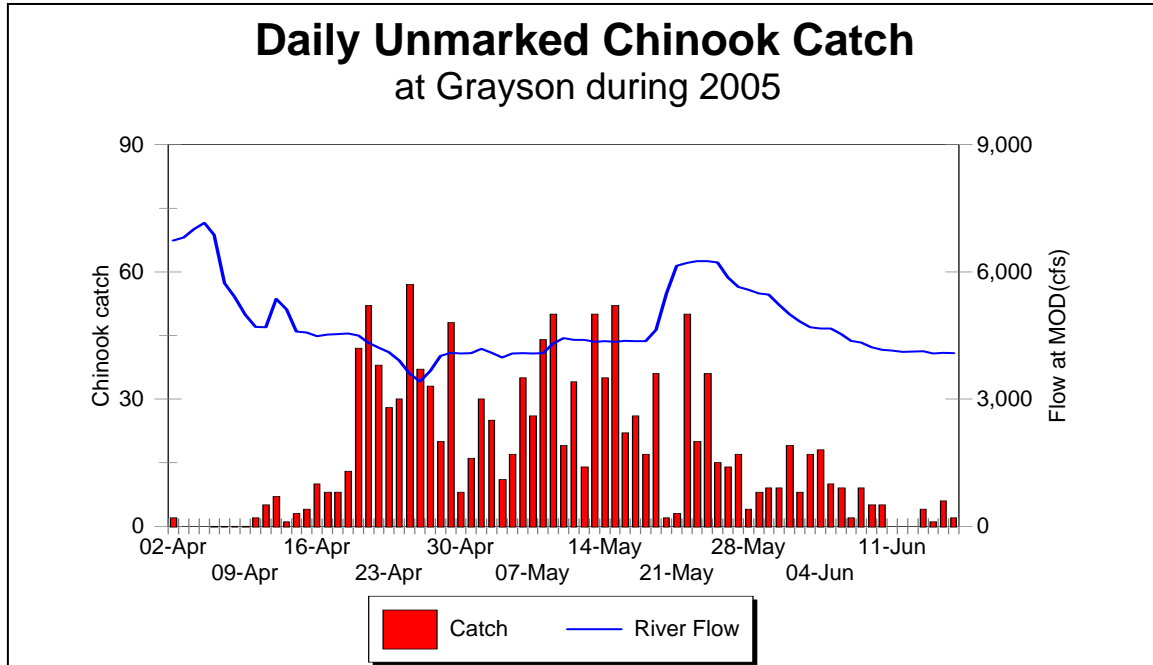


Figure 2. Daily catch of unmarked Chinook salmon at Grayson, and river flow at Modesto (MOD) during 2005.

Number of CWT Chinook Captured

Coded wire tagged fish were released by CDFG at La Grange on April 18 and the first CWTs arrived at Grayson on April 20. Daily catches of CWTs at Grayson ranged from 0 to 140 and totaled 355 (Figure 3). Catches were highest on April 20 and April 21, and approximately 70% of the total CWT catch occurred on these two days. No CWTs were captured after May 31.

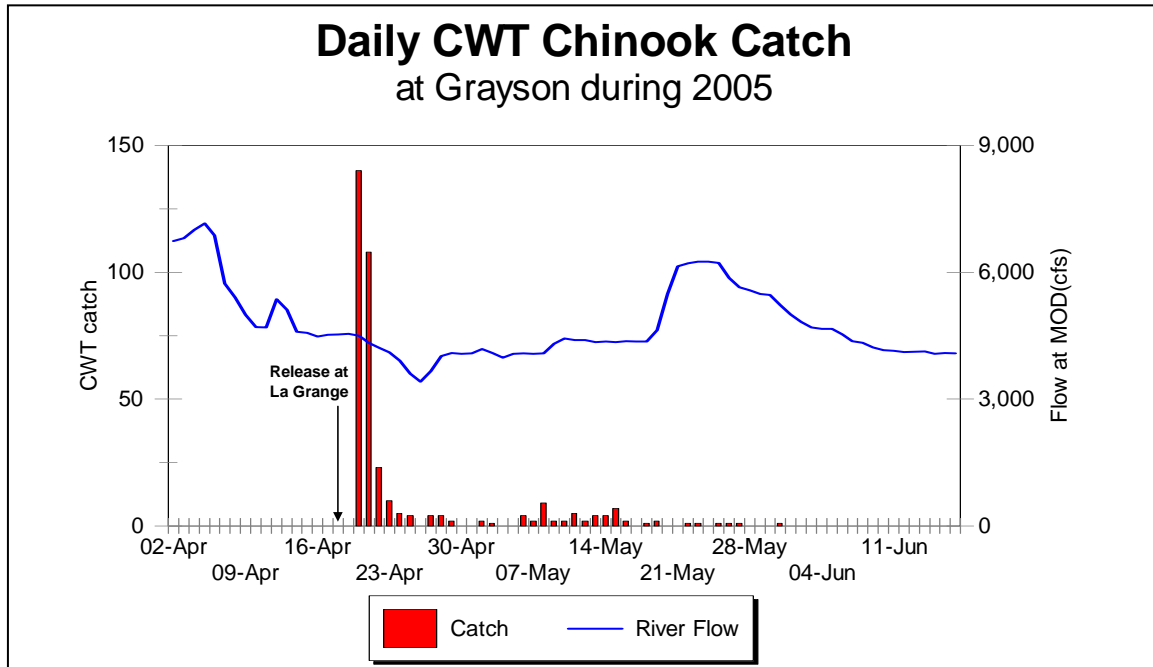


Figure 3. Daily catch of CWT marked Chinook salmon at Grayson, and river flow at Modesto (MOD) during 2005.

Trap Efficiency

River flow at Modesto during 2005 ranged between 3,410 cfs and 7,150 cfs. Seven trap efficiency tests from previous years were conducted under similar flow conditions (i.e., 3,015 cfs to 5,912 cfs;

Table 2). These seven tests were used as the basis for the regression equation used to estimate daily trap efficiencies for 2005. Potential biases associated with this approach include the possibility that trap efficiency observations in past years may not be representative of actual trap efficiencies during 2005, and that predicted trap efficiencies resulting from extrapolation beyond the range of the original data set (i.e., 10 days when flows were greater than 5,912 cfs) may be incorrect. Predicted daily trap efficiency values for 2005 are presented in Appendix A.

Table 2. Trap efficiency results from 1999 and 2000 used to derive the regression equation for predicting daily trap efficiency at Grayson during 2005.

Release Date	Origin	Adjusted # Released	Number Recaptured	% Recaptured	Avg. Length at Release (mm)	Avg. Length at Recapture (mm)	Flow (cfs) at MOD
11-Mar-99	Hatchery	1,946	28	1.4%	54	53	4,578
24-Mar-99	Hatchery	1,938	67	3.5%	61	61	3,091
29-Apr-99	Hatchery	1,959	14	0.7%	79	80	3,015
01-Mar-00	Hatchery	1,964	30	1.5%	56	53	4,506
16-Mar-00	Hatchery	1,548	22	1.4%	56	56	5,912
23-Mar-00	Hatchery	1,913	55	2.9%	59	60	3,151
06-May-00	Hatchery	1,987	41	2.1%	85	85	3,057

Daily instantaneous velocities measured in front of each trap ranged from 3.0 ft/s to 4.4 ft/s, and averaged 3.8 ft/s over the course of the sampling season. These measurements were used along with flow data from Modesto to estimate the proportion of the total river flow that passed through the traps each day, and this proportion was applied as an estimate of trap efficiency. This approach is biased in that it assumes that fish are evenly distributed throughout the water column and across the channel, and estimates based on actual mark-recapture tests are preferred because they account for the expected uneven distribution of fish within the channel.

Estimated Abundance of Unmarked Chinook

Applying the regression method, a total of 78,085 unmarked Chinook salmon were estimated to have passed Grayson between April 2 and June 17, 2005. Daily estimated passage ranged from 0 to 4,376 salmon, and peak passage occurred on May 22 following an increase in flow from approximately 4,000 to 6,000 cfs between May 18 and May 22 (Figure 4). Consistent with the trend observed for raw catch, estimated passage was also highest from late-April through late-May.

Expanding catches by the proportion of flow sampled by the traps, an estimated 31,334 unmarked Chinook salmon passed Grayson during 2005. Although this estimate is much lower than the estimate calculated by regression, the trend in passage over the course of the sampling period is similar. Because the trends are similar between both methods used to estimate trap efficiency and the regression method is preferred, all figures showing passage are based on regression.

Estimated Abundance of CWT Chinook

Applying the regression method, total of 20,149 CWT Chinook salmon were estimated to have passed Grayson. Daily estimated passage ranged from 0 to 8,119 CWT salmon, and peak passage occurred on the second and third days (e.g., April 20 and 21) following the release at La Grange.

Expanding catches by the proportion of flow sampled by the traps, an estimated 8,478 CWT Chinook salmon passed Grayson during 2005.

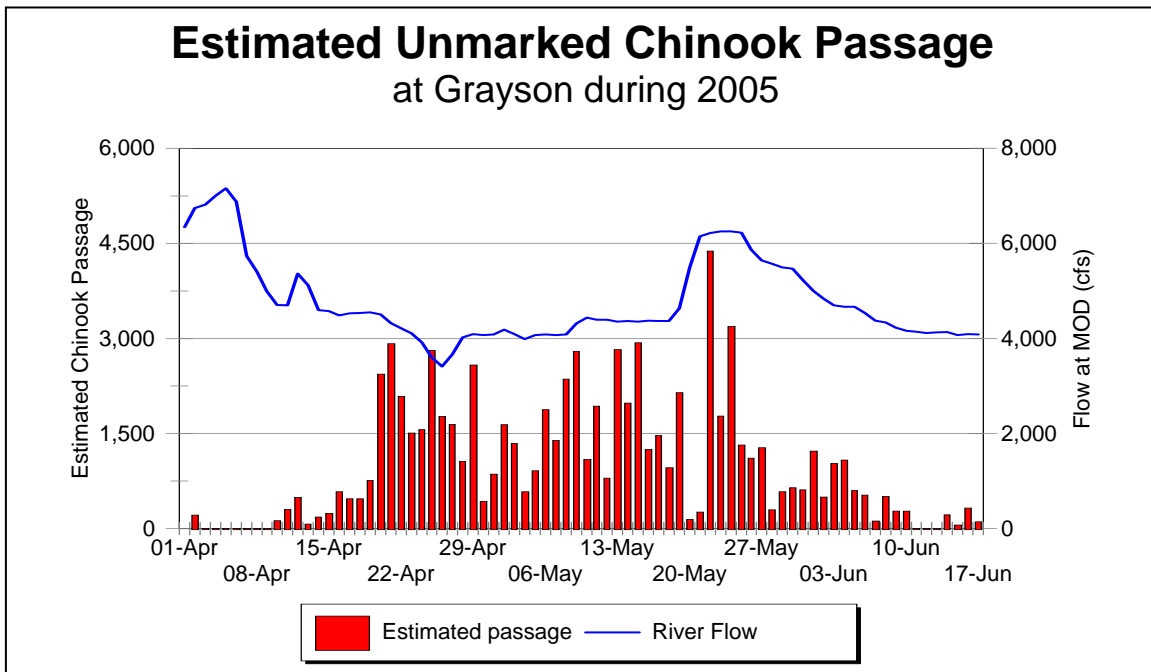


Figure 4. Daily estimated passage of unmarked Chinook salmon at Grayson and river flow at Modesto (MOD) during 2005.

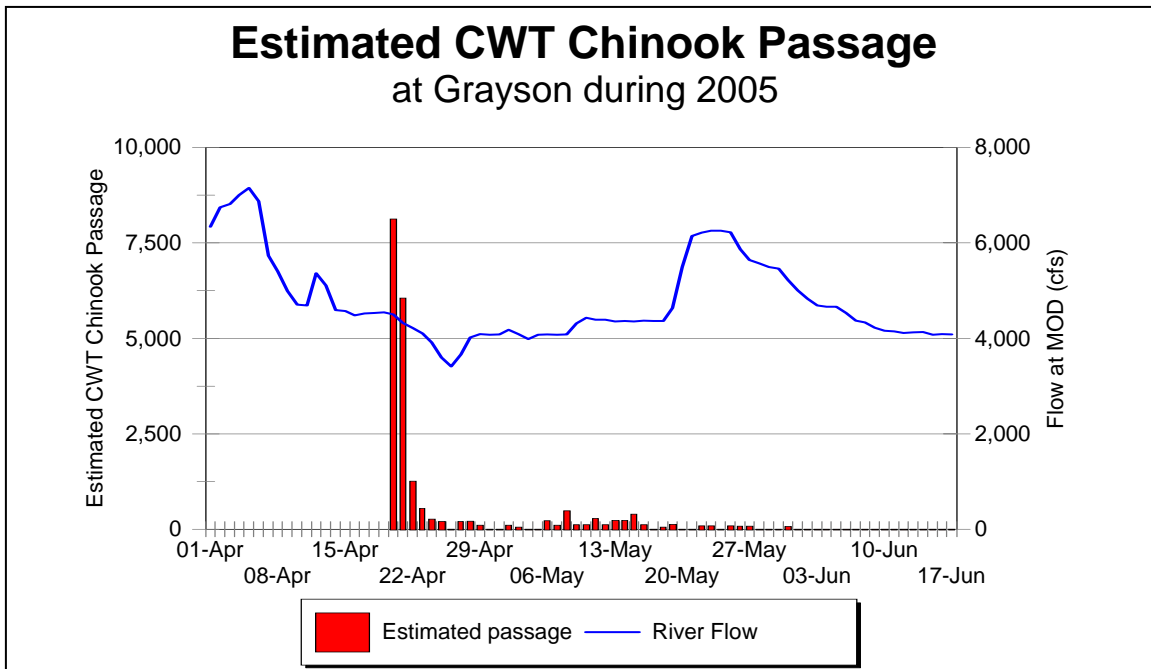


Figure 5. Daily estimated passage of CWT marked Chinook salmon at Grayson and river flow at Modesto (MOD) during 2005.

Environmental Factors

Generally, river flow at Modesto gradually declined from nearly 7,000 cfs in early April to approximately 3,000 cfs in late April (Figure 2). Flows increased shortly thereafter to approximately 4,000 cfs and remained fairly constant through mid-May. Flows then rose to approximately 6,000 cfs in late May before gradually declining to a stable flow of approximately 4,000 cfs again by June 9.

Daily average water temperatures at Shiloh varied over a relatively low and narrow range (i.e., 52.1°F to 59.1°F) during the 2005 sampling period (

Figure 6). Temperatures generally increased from early April through mid-June, and there was no clear relationship observed between water temperature and estimated passage at Grayson during 2005 (Figure 4).

Turbidity was also low and relatively stable. Daily instantaneous turbidity values fluctuated between 1.7 NTU and 4.4 NTU, and there was no clear relationship observed between turbidity and estimated passage during 2005 (Figure 7).

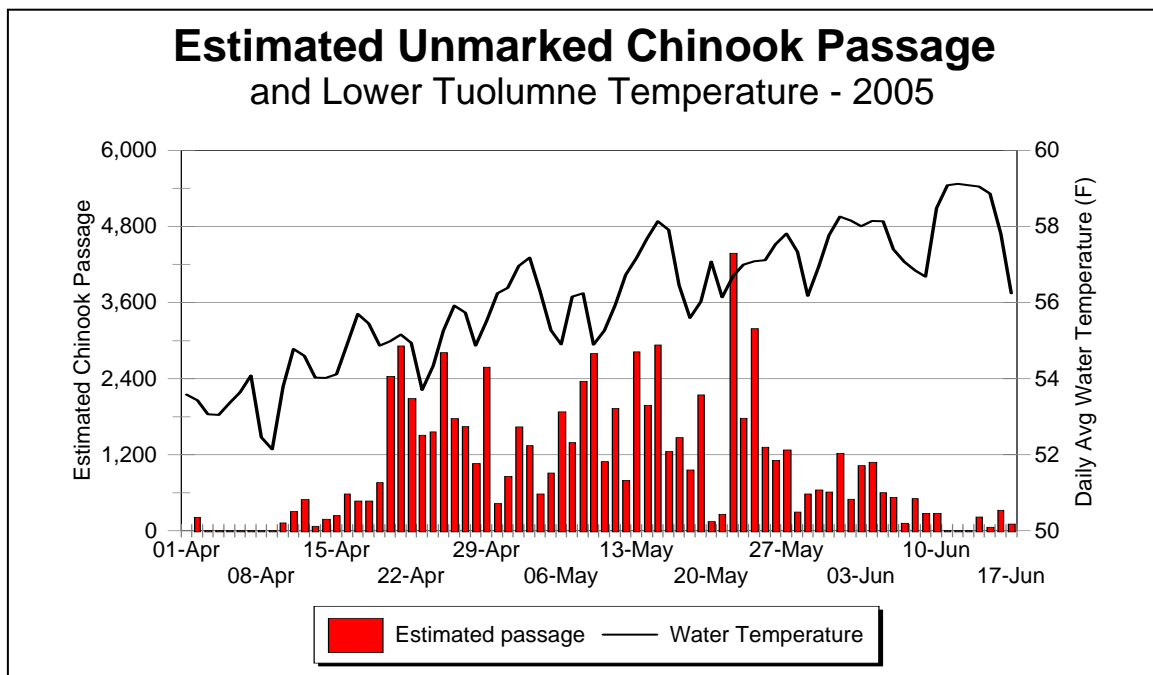


Figure 6. Daily estimated passage of unmarked Chinook salmon at Grayson and daily average water temperature at Shiloh during 2005.

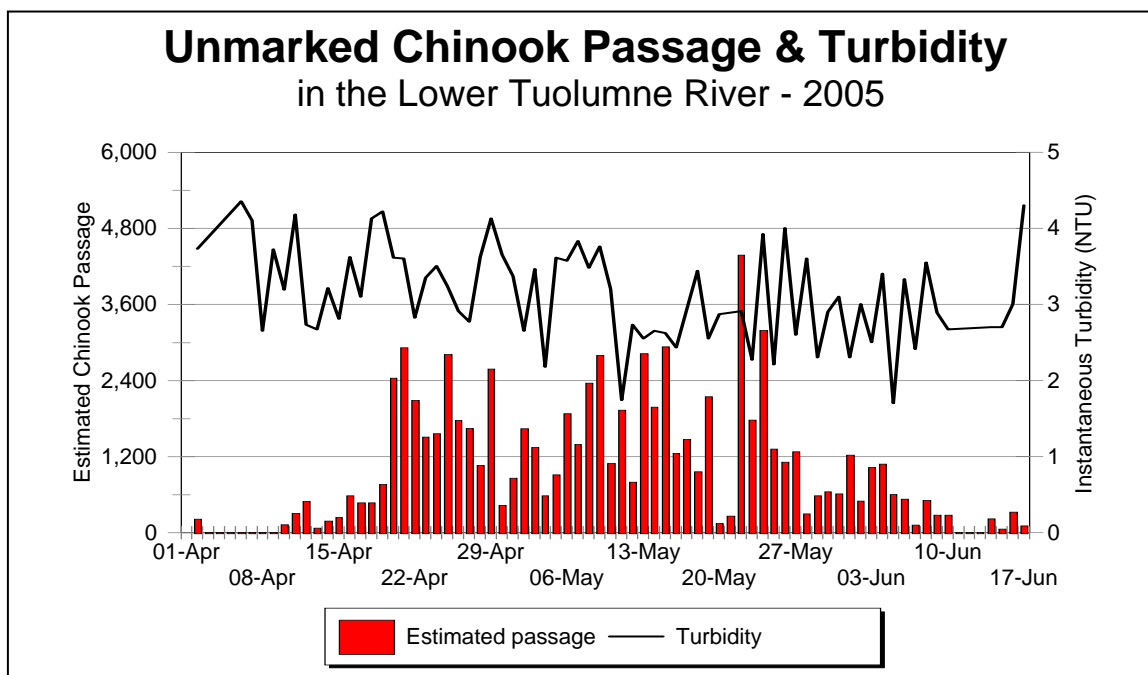


Figure 7. Daily estimated passage of unmarked Chinook salmon and instantaneous turbidity at Grayson during 2005.

Chinook Length at Capture

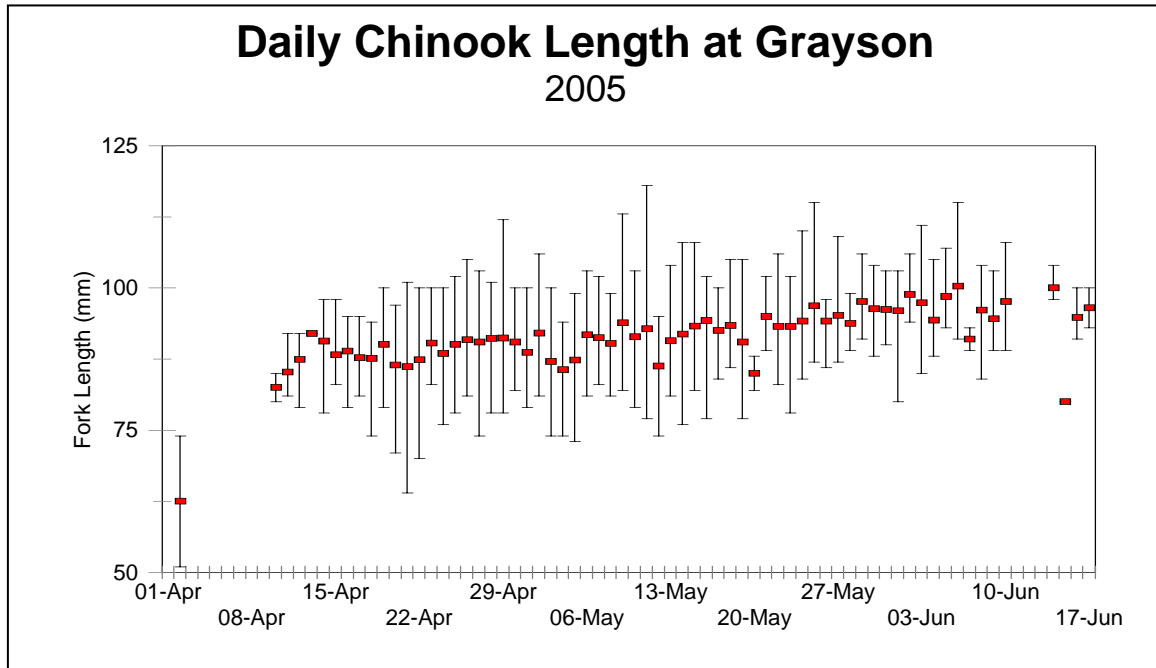
Individual forklengths of unmarked Chinook salmon captured at Grayson during 2005 ranged from 51 mm to 118 mm, and average length gradually increased from approximately 80 mm to 100 mm over the course of the sampling period with the exception of the first day of sampling when average length was about 63 mm (Figure 8). Unmarked Chinook measuring 90 mm to 99 mm were most common (51.6%), followed by those measuring 80 mm to 89 mm (33.5%) and those measuring greater than 99 mm (10.6%; Figure 10). Less than 5% of the unmarked Chinook captured at Grayson during 2005 were smaller than 80 mm forklength.

Individual forklengths of CWT marked Chinook salmon captured at Grayson during 2005 ranged from 71 mm to 113 mm. The trend in average length of CWT marked salmon was the same as that observed for unmarked Chinook, with a gradual increase from approximately 80 mm to 100 mm over the course of the sampling period. CWT Chinook measuring 80 mm to 89 mm were most common (55.8%).

Chinook Developmental Stage at Capture

All unmarked Chinook captured at Grayson during 2005 appeared to be smolting, with 99.5% classified as obvious smolts (i.e., smolt index 3). The remaining 0.5% of Chinook

were at an intermediate stage of smolting and classified as smolt index 2. All CWT



Chinook were classified as obvious smolts.

Figure 8. Daily minimum, average, and maximum fork lengths of unmarked Chinook salmon captured at Grayson during 2005.

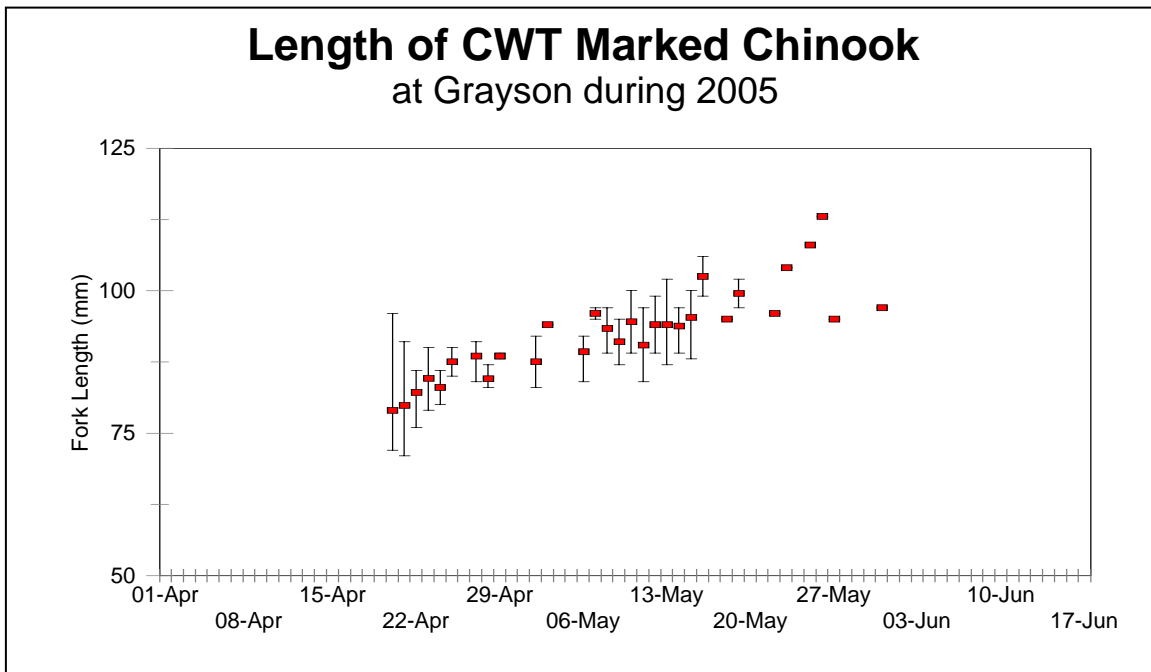
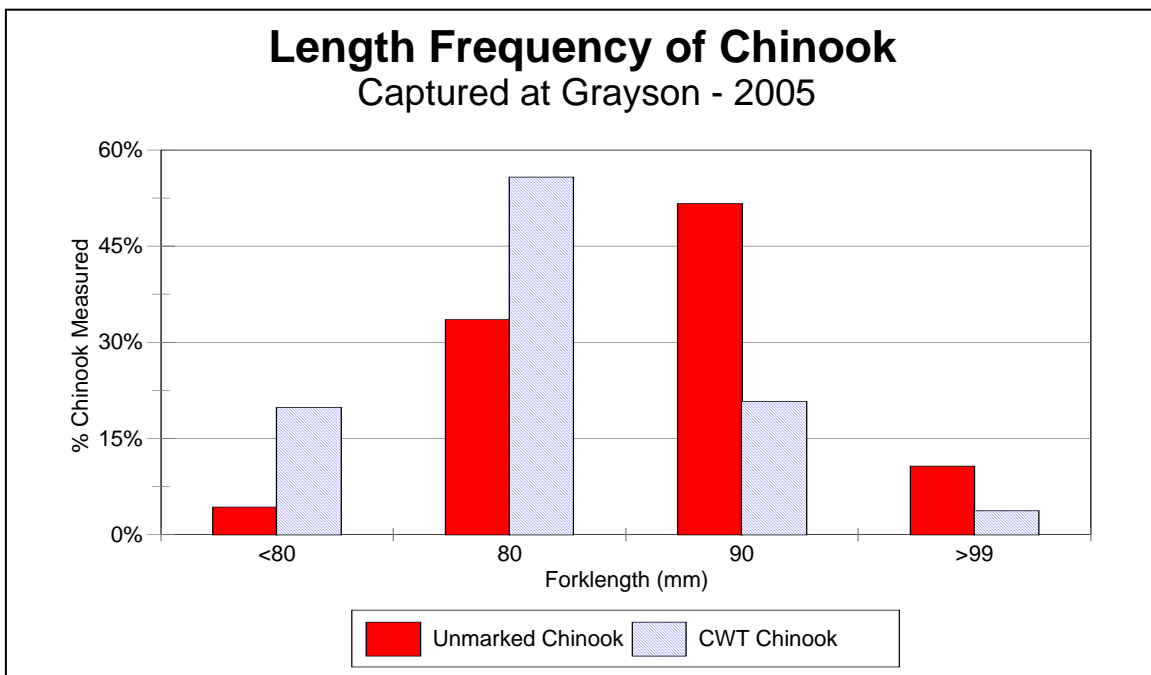


Figure 9. Daily minimum, average, and maximum fork lengths of CWT marked Chinook salmon



captured at Grayson during 2005.

Figure 10. Length frequency of unmarked and CWT marked Chinook salmon captured at Grayson during 2005.

Rainbow/steelhead trout

One rainbow/steelhead trout fry measuring 33 mm was captured at Grayson on May 14.

Other Fish Species Captured

A total of 195 non-salmonids representing at least 19 species (6 native, 13 introduced) were captured during operation of the Grayson traps in 2005 (

Table 3 and Appendix B). Catch of non-salmonids was dominated by introduced species including white catfish, channel catfish, golden shiner, red shiner, fathead minnow, goldfish, mosquitofish, inland silverside, bluegill, redear sunfish, warmouth, largemouth bass, and smallmouth bass. Native non-salmonid species captured included hardhead, hitch, Sacramento sucker, Sacramento pikeminnow, lamprey, and tule perch. Lamprey captured in the traps were primarily ammocoetes and were not identified to species or measured.

Table 3. Non-salmonid species captured at Grayson during 2005. Native species are indicated in bold.

Common Name	Scientific Name	Total Catch	Minimum Length (mm)	Average Length (mm)	Maximum Length (mm)
<i>Catfish Family</i>					
Channel catfish	<i>Ictalurus punctatus</i>	3	58	74.3	100
White catfish	<i>Ictalurus catus</i>	51	41	64.7	160
<i>Lamprey Family</i>					
Lamprey - unidentified	-	13	-	-	-
<i>Livebearer Family</i>					
Mosquitofish	<i>Gambusia affinis</i>	10	22	31.6	44
<i>Minnow Family</i>					
Fathead minnow	<i>Pimephales promelas</i>	1	53	53.0	53
Hardhead	<i>Mylopharodon conocephalus</i>	2	47	48.5	50
Hitch	<i>Lavinia exilicauda</i>	1	54	54.0	54
Goldfish	<i>Carassius auratus</i>	2	163	286.5	410
Golden shiner	<i>Notemigonus crysoleucas</i>	10	37	55.5	97
Red shiner	<i>Cyprinella lutrensis</i>	5	37	49.2	63
Sac. pikeminnow	<i>Ptychocheilus grandis</i>	42	34	54.8	90
<i>Silverside Family</i>					
Inland silverside	<i>Menidia beryllina</i>	5	35	64.6	91
<i>Sucker Family</i>					

Sacramento sucker	<i>Catostomus occidentalis</i>	4	29	35.5	44
<i>Sunfish Family</i>					
Bluegill	<i>Lepomis macrochirus</i>	19	30	68.1	243
Largemouth bass	<i>Micropterus salmoides</i>	15	24	34.6	42
Redear Sunfish	<i>Lepomis microlophus</i>	1	122	122.0	122
Smallmouth bass	<i>Micropterus dolomieu</i>	6	41	68.3	115
Warmouth	<i>Lepomis gulosus</i>	1	56	56.0	56
<i>Surfperch Family</i>					
Tule Perch	<i>Hysterocarpus traski</i>	1	34	34.0	34
Unidentified species	-	3	23	25.3	28

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Appendix A. Daily Chinook catch, length, and passage at Grayson and environmental data from 2005.

Date	Unmarked Chinook Salmon						CWT Chinook Salmon						Predicted	Estimated	Flow at		Velocity		Temp	
	Catch	Min	Avg	Max	Regress	% Volume	Catch	Min	Avg	Max	Regress	% Volume	Efficiency (Regress)	Proportion of Flow Sampled	MOD (cfs)	North	South	at Shiloh	Turbidity	
01-Apr-05															6340				53.6	
02-Apr-05	2	51	62.5	74	208	71							0.0096	0.0280	6740	3.6	3.9	53.4	3.7	
03-Apr-05	ns	ns	ns	ns	0	0							0.0094	0.0000	6810	ns	ns	53.1	ns	
04-Apr-05	ns	ns	ns	ns	0	0							0.0087	0.0000	7000	ns	ns	53.0	ns	
05-Apr-05	ns	ns	ns	ns	0	0							0.0082	0.0000	7150	ns	ns	53.4	ns	
06-Apr-05	0	-	-	-	0	0							0.0092	0.0295	6870	4.4	3.7	53.6	4.4	
07-Apr-05	0	-	-	-	0	0							0.0131	0.0355	5730	4.1	4.0	54.1	4.1	
08-Apr-05	0	-	-	-	0	0							0.0142	0.0384	5400	4.2	4.1	52.5	2.7	
09-Apr-05	0	-	-	-	0	0							0.0156	0.0366	4990	3.8	¹ 3.5	52.1	3.7	
10-Apr-05	2	80	82.5	85	121	54							0.0166	0.0368	4700	3.8	¹ 3.1	53.8	3.2	
11-Apr-05	5	81	85.2	92	301	126							0.0166	0.0397	4690	3.7	3.7	54.8	4.2	
12-Apr-05	7	79	87.4	92	489	187							0.0143	0.0375	5360	4.0	4.0	54.6	2.7	
13-Apr-05	1	92	92.0	92	66	24							0.0152	0.0425	5110	4.4	4.2	54.0	2.7	
14-Apr-05	3	78	90.7	98	177	74							0.0169	0.0408	4590	3.7	3.8	54.0	3.2	
15-Apr-05	4	83	88.3	98	235	95							0.0170	0.0422	4570	3.9	3.8	54.1	2.8	
16-Apr-05	10	79	88.9	95	578	230							0.0173	0.0434	4480	3.8	3.9	54.9	3.6	
17-Apr-05	8	81	87.7	95	466	189							0.0172	0.0422	4520	3.8	¹ 3.8	¹ 55.7	3.1	
18-Apr-05	8	74	87.6	94	467	198							0.0171	0.0405	4530	3.6	3.7	55.4	4.1	
19-Apr-05	13	79	90.1	100	760	313							0.0171	0.0415	4540	3.6	3.9	54.9	4.2	
20-Apr-05	42	71	86.5	97	2,436	1,103	140	72	79.0	96	8,119	3,677	0.0172	0.0381	4500	3.1	3.8	55.0	3.6	
21-Apr-05	52	64	86.1	101	2,912	1,132	108	71	79.8	91	6,048	2,351	0.0179	0.0459	4320	4.1	3.8	55.2	3.6	
22-Apr-05	38	70	87.4	100	2,084	885	23	76	82.1	86	1,262	535	0.0182	0.0430	4210	3.6	3.6	54.9	2.8	
23-Apr-05	28	83	90.3	100	1,505	609	10	79	84.6	90	537	217	0.0186	0.0460	4100	3.8	3.8	53.7	3.4	
24-Apr-05	30	76	88.5	100	1,558	669	5	80	83.0	86	260	111	0.0193	0.0448	3910	3.5	3.5	54.3	3.5	
25-Apr-05	57	78	90.1	102	2,807	1,219	4	85	87.5	90	197	86	0.0203	0.0468	3600	3.4	3.3	55.3	3.2	
26-Apr-05	37	81	90.9	105	1,766	837					0	0	0.0210	0.0442	3410	3.0	3.0	55.9	2.9	
27-Apr-05	33	74	90.5	103	1,642	740	4	84	88.5	91	199	90	0.0201	0.0446	3660	3.2	3.3	55.7	2.8	
28-Apr-05	20	78	91.2	101	1,059	433	4	83	84.5	87	212	87	0.0189	0.0462	4020	3.7	3.7	54.9	3.6	
29-Apr-05	48	78	91.2	112	2,575	1,101	2	88	88.5	89	107	46	0.0186	0.0436	4090	3.5	3.6	55.5	4.1	
30-Apr-05	8	82	90.5	100	428	180					0	0	0.0187	0.0444	4070	3.6	3.6	56.2	3.7	
01-May-05	16	79	88.7	100	857	382					0	0	0.0187	0.0419	4080	3.2	3.6	56.4	3.4	
02-May-05	30	81	92.1	106	1,636	703	2	83	87.5	92	109	47	0.0183	0.0427	4180	3.4	3.7	57.0	2.7	

Date	Unmarked Chinook Salmon						CWT Chinook Salmon						Predicted	Estimated	Flow at MOD (cfs)	Velocity		Temp at Shiloh	Turbidity
	Catch	Fork Length (mm)			Estimated Passage		Catch	Fork Length (mm)			Estimated Passage		Efficiency (Regress)	Proportion of Flow Sampled		North	South		
03-May-05	25	74	87.1	100	1,341	558	1	94	94.0	94	54	22	0.0186	0.0448	4090	3.6	3.7	57.2	3.5
04-May-05	11	74	85.6	94	579	239					0	0	0.0190	0.0461	3980	3.6	3.7	56.3	2.2
05-May-05	17	73	87.4	99	909	383					0	0	0.0187	0.0444	4070	3.7	3.5	55.3	3.6
06-May-05	35	81	91.7	103	1,874	758	4	84	89.3	92	214	87	0.0187	0.0462	4080	3.8	3.7	54.9	3.6
07-May-05	26	83	91.3	102	1,390	582	2	95	96.0	97	107	45	0.0187	0.0447	4070	3.6	3.6	56.2	3.8
08-May-05	44	81	90.3	99	2,356	953	9	89	93.3	97	482	195	0.0187	0.0462	4080	3.7	3.8	56.2	3.5
09-May-05	50	82	93.9	113	2,795	1,144	2	87	91.0	95	112	46	0.0179	0.0437	4310	3.8	3.7	54.9	3.8
10-May-05	19	79	91.4	103	1,087	423	2	89	94.5	100	114	45	0.0175	0.0449	4430	3.9	4.0	55.3	3.2
11-May-05	34	77	92.8	118	1,930	772	5	84	90.4	97	284	113	0.0176	0.0441	4390	3.8	3.9	55.9	1.7
12-May-05	14	74	86.3	95	795	314	2	89	94.0	99	114	45	0.0176	0.0446	4390	4.0	3.8	56.7	2.7
13-May-05	50	81	90.7	104	2,816	1,124	4	87	94.0	102	225	90	0.0178	0.0445	4350	3.9	3.8	57.2	2.6
14-May-05	35	76	91.9	108	1,975	798	4	89	93.8	97	226	91	0.0177	0.0438	4360	4.0	3.7	57.7	2.7
15-May-05	52	82	93.3	108	2,929	1,217	7	88	95.3	100	394	164	0.0178	0.0427	4350	3.7	3.7	58.1	2.6
16-May-05	22	77	94.3	102	1,244	532	2	99	102.5	106	113	48	0.0177	0.0414	4370	3.7	3.5	57.9	2.4
17-May-05	26	84	92.5	100	1,467	618					0	0	0.0177	0.0421	4360	3.8	1 3.5	56.5	2.9
18-May-05	17	86	93.4	105	959	388	1	95	95.0	95	56	23	0.0177	0.0438	4360	3.8	1 3.8	1 55.6	3.4
19-May-05	36	77	90.5	105	2,143	851	2	97	99.5	102	119	47	0.0168	0.0423	4630	4.0	3.8	56.0	2.6
20-May-05	2	82	85.0	88	144	56					0	0	0.0139	0.0357	5490	3.8	1 4.0	57.1	2.9
21-May-05	3	89	95.0	102	257	89					0	0	0.0117	0.0335	6140	4.4	3.8	1 56.1	
22-May-05	50	83	93.2	106	4,376	1,437	1	96	96.0	96	88	29	0.0114	0.0348	6210	4.2	4.4	56.7	2.9
23-May-05	20	78	93.3	102	1,771	614	1	104	104.0	104	89	31	0.0113	0.0326	6250	3.8	1 4.3	57.0	2.3
24-May-05	36	84	94.2	110	3,188	1,054					0	0	0.0113	0.0342	6250	4.3	4.2	57.1	3.9
25-May-05	15	87	96.9	115	1,317	422	1	108	108.0	108	88	28	0.0114	0.0355	6220	4.4	4.4	57.1	2.2
26-May-05	14	86	94.1	98	1,110	398	1	113	113.0	113	79	28	0.0126	0.0352	5860	4.1	4.1	57.5	4.0
27-May-05	17	87	95.2	109	1,272	460	1	95	95.0	95	75	27	0.0134	0.0370	5640	4.2	4.1	57.8	2.6
28-May-05	4	89	93.8	99	294	111					0	0	0.0136	0.0361	5570	4.1	3.9	57.3	3.6
29-May-05	8	91	97.6	106	577	221					0	0	0.0139	0.0361	5490	4.1	3.8	56.2	2.3
30-May-05	9	88	96.3	104	644	242					0	0	0.0140	0.0373	5460	4.2	3.9	56.9	2.9
31-May-05	9	90	96.2	103	608	243	1	97	97.0	97	68	27	0.0148	0.0371	5220	3.8	1 3.9	57.8	3.1
01-Jun-05	19	80	96.0	103	1,222	485					0	0	0.0155	0.0392	5000	3.9	3.9	58.3	2.3
02-Jun-05	8	94	98.9	106	496	205					0	0	0.0161	0.0390	4830	3.9	3.6	58.1	3.0
03-Jun-05	17	85	97.4	111	1,024	429					0	0	0.0166	0.0396	4690	3.7	3.7	58.0	2.5
04-Jun-05	18	88	94.3	105	1,078	452					0	0	0.0167	0.0398	4660	3.7	3.6	58.1	3.4
05-Jun-05	10	93	98.5	107	599	241					0	0	0.0167	0.0415	4660	3.8	3.9	58.1	1.7

Date	<u>Unmarked Chinook Salmon</u>						<u>CWT Chinook Salmon</u>						Predicted	Estimated	Flow at MOD (cfs)	Velocity		Temp at Shiloh	Turbidity
	Catch	Fork Length (mm)			Estimated Passage		Catch	Fork Length (mm)			Estimated Passage		Efficiency (Regress)	Proportion of Flow Sampled		North	South		
06-Jun-05	9	91	100.3	115	525	214					0	0	0.0171	0.0421	4530	3.8	3.8	57.4	3.3
07-Jun-05	2	89	91.0	93	113	47					0	0	0.0177	0.0425	4370	3.8	¹ 3.6	57.1	2.4
08-Jun-05	9	84	96.1	104	505	199					0	0	0.0178	0.0453	4330	3.9	3.9	56.8	3.6
09-Jun-05	5	89	94.6	103	275	112					0	0	0.0182	0.0446	4220	3.8	3.7	56.7	2.9
10-Jun-05	5	89	97.6	108	272	115					0	0	0.0184	0.0435	4160	3.6	3.6	58.5	2.7
11-Jun-05	ns	ns	ns	ns	0	0					0	0	0.0185	0.0000	4140	ns	ns	59.1	ns
12-Jun-05	ns	ns	ns	ns	0	0					0	0	0.0186	0.0000	4110	ns	ns	59.1	ns
13-Jun-05	ns	ns	ns	ns	0	0					0	0	0.0185	0.0000	4120	ns	ns	59.1	ns
14-Jun-05	4	98	100.0	104	216	85					0	0	0.0185	0.0468	4130	3.9	3.8	59.0	2.7
15-Jun-05	1	80	80.0	80	53	21					0	0	0.0187	0.0469	4070	3.8	¹ 3.8	¹ 58.9	2.7
16-Jun-05	6	91	94.8	100	322	132					0	0	0.0186	0.0454	4090	3.7	3.7	57.8	3.0
17-Jun-05	2	93	96.5	100	107	43					0	0	0.0187	0.0462	4080	3.8	3.7	56.2	4.3
¹ No measurement taken. Average seasonal velocity was substituted.																			

Appendix B. Daily counts of non-salmonids captured at Grayson during 2005.

Date	BGS	CHC	FHM	GF	GSN	HCH	HH	LAM	LMB	MQK	MSS	RES	RSN	SASQ	SASU	SMB	TP	UNID	W	WHC
2-Apr								2		2				11						2
3-Apr																				
4-Apr																				
5-Apr																				
6-Apr							1							5						3
7-Apr														2						1
8-Apr										4	1			2				1		1
9-Apr								1						3						
10-Apr					1								1							
11-Apr	1											1		2						2
12-Apr					1									1						1
13-Apr								1						2						
14-Apr					1									1						2
15-Apr					1						1			1						
16-Apr																1				
17-Apr																				
18-Apr	1																			1
19-Apr								2												3
20-Apr																				1
21-Apr		1			1									1		1				1
22-Apr	2							1												
23-Apr								2						1						
24-Apr					1											1				
25-Apr	1													1						
26-Apr	1				1	1								4						
27-Apr	8													1						2
28-Apr														1						1
29-Apr																		1		
30-Apr	1																			
1-May														1		1				
2-May																				2
3-May																				
4-May					1															3
5-May				1																
6-May																				
7-May																				1
8-May											1									1
9-May				1																2

Date	BGS	CHC	FHM	GF	GSN	HCH	HH	LAM	LMB	MQK	MSS	RES	RSN	SASQ	SASU	SMB	TP	UNID	W	WHC
10-May																				
11-May																				1
12-May		1																		2
13-May		1																		1
14-May																				1
15-May																				
16-May																				
17-May																				1
18-May																				1
19-May																				
20-May															1					
21-May																				
22-May														1						2
23-May								3			1				1					
24-May								1								1				2
25-May																				2
26-May										2										1
27-May														1			1			2
28-May																				
29-May																				
30-May																				
31-May															1			1		
1-Jun	1												1							
2-Jun									1				1							1
3-Jun	1																			1
4-Jun							1		1											
5-Jun									4									1		
6-Jun	1								1											
7-Jun										1										
8-Jun									6		1									2
9-Jun	1												1			1				
10-Jun										1										
11-Jun																				
12-Jun																				
13-Jun																				
14-Jun			1										1							1
15-Jun					2															
16-Jun									1						1					
17-Jun									1											
Total	19	3	1	2	10	1	2	13	15	10	5	1	5	42	4	6	1	3	1	51

Key to species codes

BGS	Bluegill
CHC	Channel catfish
CHNF	Chinook
FHM	Fathead minnow
GF	Goldfish
GSF	Green sunfish
GSN	Golden shiner
HH	Hardhead
HCH	Hitch
LAM	Lamprey, unidentified species
LMB	Largemouth bass
MQK	Mosquitofish
MSS	Inland silverside
RBT	Rainbow trout
RES	Redear sunfish
RSN	Red shiner
SASQ	Sacramento pikeminnow
SASU	Sacramento sucker
SMB	Smallmouth bass
TP	Tule perch
UNID	Unidentified species
W	Warmouth
WHC	White catfish